Going against the grain: carbohydrate reduction in the management of type 2 diabetes

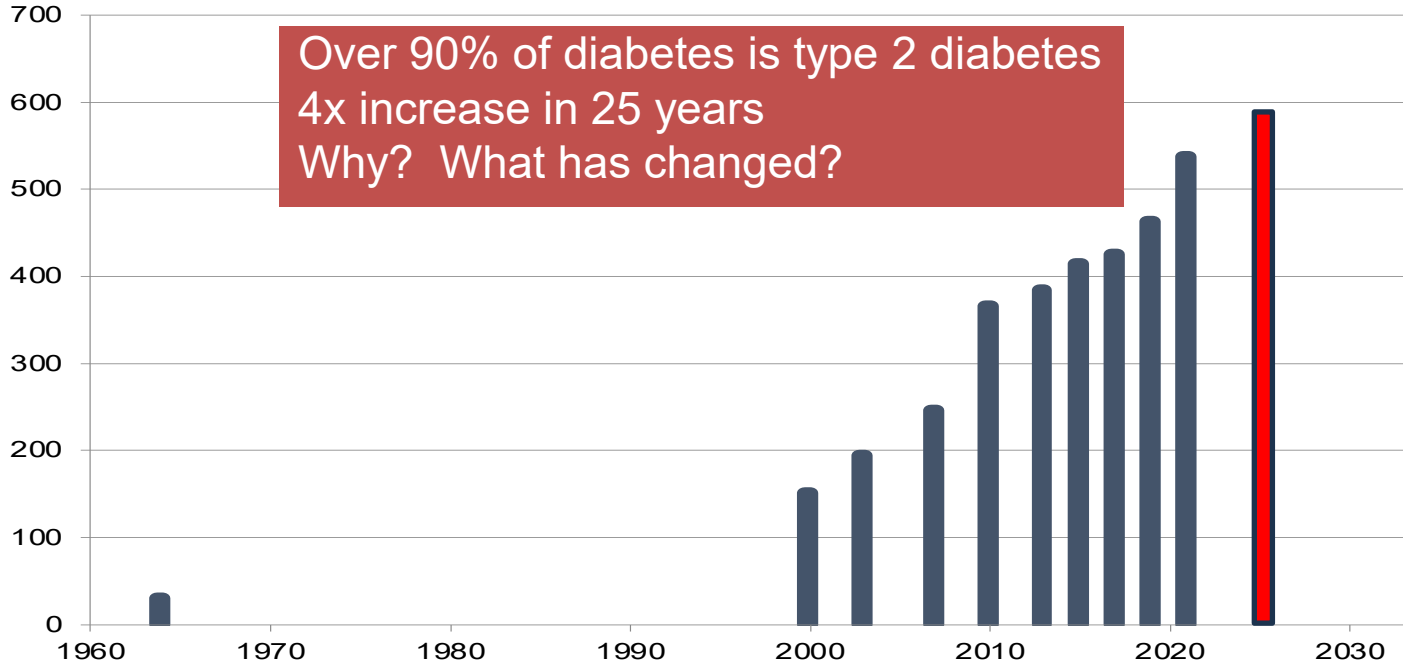
Dr David Cavan, Consultant Endocrinologist
University Hospitals Dorset
d.cavan@nhs.net www.thediabetesdoctor.com

What is type 2 diabetes?

- Type 2 diabetes is a common condition where the hormone insulin does not work properly (insulin resistance), or it is deficient.
- Insulin helps the body use glucose (sugar) for energy, by taking it from the blood to the cells.
- Without effective insulin, the level of glucose in the blood becomes too high.
- The foods that cause blood glucose to increase the most are carbohydrates (sugars and starches)

- Throughout history until the 20th century, this condition of carbohydrate intolerance was managed by restricting dietary carbohydrates

Estimated cases of diabetes (millions)



Lifestyle

Lifestyle and risk of type 2 diabetes



Sitting



2hrs / day: +20% risk
5hrs / day: +50% risk



Sugar



+18% risk

Starches



+11% risk

Junk Food



What should a person with type 2 diabetes be advised to eat?

Laverty et al. Am J Prev Med 2013
Grontved A. JAMA 2011, 305

Ley SH, et al. Prevention and Management of Type 2 Diabetes: Dietary Components and Nutritional Strategies. Lancet 2014; 383: 1999-2007.

Dietary management of diabetes before insulin

Table 1. Dietary restriction to control diabetes prior to availability of insulin[19-25]

Physician	Country	Treatment regimen
Thomas Willis (1621–1675)	England	Food restriction, lime water
John Rollo (1749–1809)	England	High protein, high fat, low carbohydrate, anorectic substances
Apollinaire Bouchardat (1809–1996)	France	Food restriction, include vegetables, avoid alcohol. Need for individualisation of diet
Arnaldo Cantani (1837–1893)	Italy	Meat only diet, no carbohydrates, lactic acid
Karl A. Petren (1868–1927)	Sweden	High protein, high fat, low carbohydrate
Elliott P. Joslin (1869–1962)	USA	Calorie restricted, low carbohydrate, exercise
Frederick M. Allen (1879–1964)	USA	Calorie restriction (starvation diet), high fat, high protein, very low carbohydrate
George Graham (1882–1971)	England	Starvation diet (similar to Allen's), bed rest, minimal physical activity

Day C , Bailey C J British Journal of Diabetes & Vascular Disease 2012;12:48-51

In 1797 John Rollo, a surgeon in the Royal Artillery and William Cruickshank, a fellow surgeon who was also a chemist - published 'An account of two cases of the diabetes mellitus' in which they described the treatment and monitoring of two officers who received strict vegetable-free diets (~1,500 calories/day) low in carbohydrate and high in protein and fat (rancid meat and blood pudding) plus medications to reduce appetite. In the longitudinal study of Captain Meredith who weighed 16 st 8 lbs and was suffering from dehydration they noted the quantity and nature of the sugars in his blood and urine and how these altered in response to treatment. Within 3 months he had lost 50 lbs in weight, his urinary output had decreased from > 25 to < 5 pints a day, he was free of glycosuria and considered cured of diabetes. The other officer also responded to the low calorie, low carbohydrate diet, but he eventually found the dietary restriction intolerable and 3 months before his death, at 57years of age, he informed Rollo that he had returned to an unrestricted diet.

Dietary recommendations for diabetes

Dietary composition	1930s[4]
Carbohydrate (% energy)	15% (75g)
Fat (% energy)	68%
Protein (% energy)	17%
Added sucrose	None

adapted from: Thomas B, Practical Diabetes Int 2004; 21:69-72

(grams based on 2000kcal diet)

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Protein (% energy)	17%
Added sucrose	None



1980s[2]	1990s[5]
Diabetes UK guidelines	
>50%	50–55%
<35%	30–35%
15%	10–15%
Small amounts as part of mixed meals	<25g/day

(250-275g)

adapted from: Thomas B, Practical Diabetes Int 2004; 21:69-72

(grams based on 2000kcal diet)

The evidence for a higher carbohydrate diet?

- 14 people with type 2 diabetes
- High carb (350g/ day) for 6 weeks
  - low fat (skimmed milk and Flora margarine) and **sugar excluded**

- Standard ‘Low’ carb (220g/day) for 6 weeks
  - butter, whole milk, **sugar included**

- Total cholesterol was higher after the ‘low’ carb diet (5.1 vs 4.4)
  - No sig diff in TG, HDL, LDL or VLDL
- Fasting glucose was higher after the 'low' carb diet (7.4 vs 6.5)

Funded by Flora Information Service and the International Sugar Foundation Inc

BMJ 1979, 6180 1753-1756

Dietary recommendations for diabetes

Diet and diabetes – the new recommendations

Journal of Diabetes Nursing Vol 8 No 4 2004

Table 1. Summary of nutritional recommendations for people with diabetes

Nutrient	Recommendations for diabetes
Protein	Not > 1 g per kg bodyweight
Total fat (% total energy intake)	< 35%
Saturated and transunsaturated fat	< 10%
n-6 polyunsaturated fat*	< 10%
n-3 polyunsaturated fat**	Eat oily fish once or twice a week
cis-monounsaturated fat***	10–25%
Total carbohydrate (% total energy intake)	60–70% of total energy intake
	45–60%
Sucrose	Up to 10%
Dietary fibre	No quantitative recommendation
Vitamins and antioxidants	Encourage foods naturally rich in vitamins and antioxidants
Salt (g/day)	< 6

**n-6 polyunsaturated, the most common kind of polyunsaturated fat, is found in sunflower and corn oil.*

***n-3 polyunsaturated fat, less common, is found in oily fish (salmon, mackeral, sardines.*

****cis-monounsaturated fat is found in olive oil and rapeseed oil*

50g sugar per day

The evidence for a higher sugar diet?!

- 12 people with type 2 diabetes
- 2 standardized mixed meals, matched for macronutient but one had 20g sucrose
- No difference in glucose level between meals

- Conclusion
  - sucrose has similar effect to complex carbs and can be included

Lancet 1984, 324, 122-125

The evidence for a higher sugar diet?!

- 12 people with type 2 diabetes
- 2 standardized mixed meals, matched for macronutient but one had 20g sucrose
- No difference in glucose level between meals

- Conclusion

– sucrose has similar effect to complex carbs and can be included

NOT - Complex carbs have similar effect to sucrose and should be excluded

Lancet 1984, 324, 122-125

There was no high-quality evidence to justify the shift from low to higher carbohydrate recommendations for management of type 2 diabetes

My timeline (its very long…)

- 1985 – qualified as doctor in Southampton
- 1986 – my first diabetes clinics (Midlands), carbohydrate restriction was the norm; carb ‘prescription’ for patients on insulin

- 1996 – Consultant in Bournemouth – no such thing as a diabetic diet, just follow a healthy low fat, high fibre diet

- 2007 – Sitagliptin (DPP4i) and Byetta (GLP1ra) launched with much hype
- 2008 - I had a new focus on type 2 diabetes

2009-2011 - Lightbulb moments

Food groups and what's in a portion	How many portions do you eat in a day?	How many portions should you eat in a day?
Bread, cereals, rice, pasta and potatoes One portion is equal to: • 2–4 tbsp cereal • 1 slice of bread • Half a small chapati • 2–3 crispbreads or crackers • 2–3 tbsp rice, pasta, cous-cous, noodles or mashed potato • 2 new potatoes or half a baked potato	I eat...	**7–14** Include starchy foods at all meals

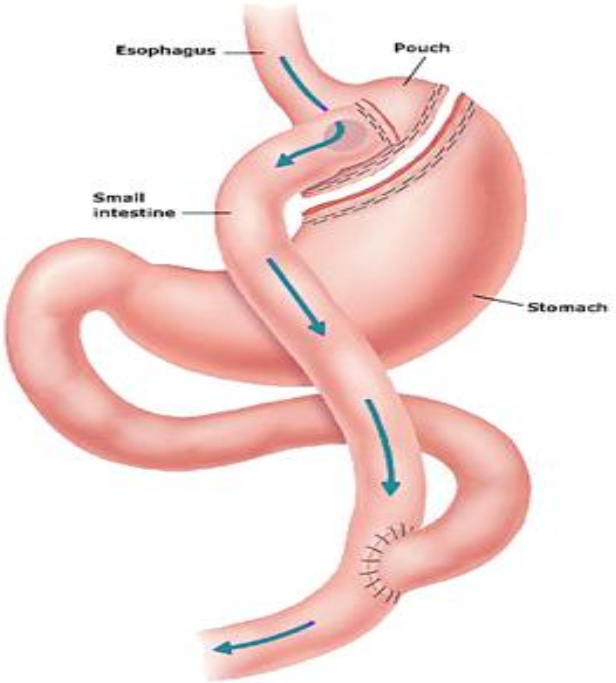
Diabetes UK 2012

- In many people the new drugs didn’t make any difference
- I started asking people what they eat - carbs including sugar with most meals
- I suggested reducing carbs rather than adding medications
- I saw HbA1c and meds usage (including insulin) tumble
- Counterpoint was published

Counterpoint – inspired by bariatric surgery

- Bariatric surgery for weight loss

- Effects in people with diabetes
  - Significant weight loss
  - Normal glucose tolerance
    - they no longer have diabetes



2011 – Counterpoint study

11 obese people with type 2 diabetes

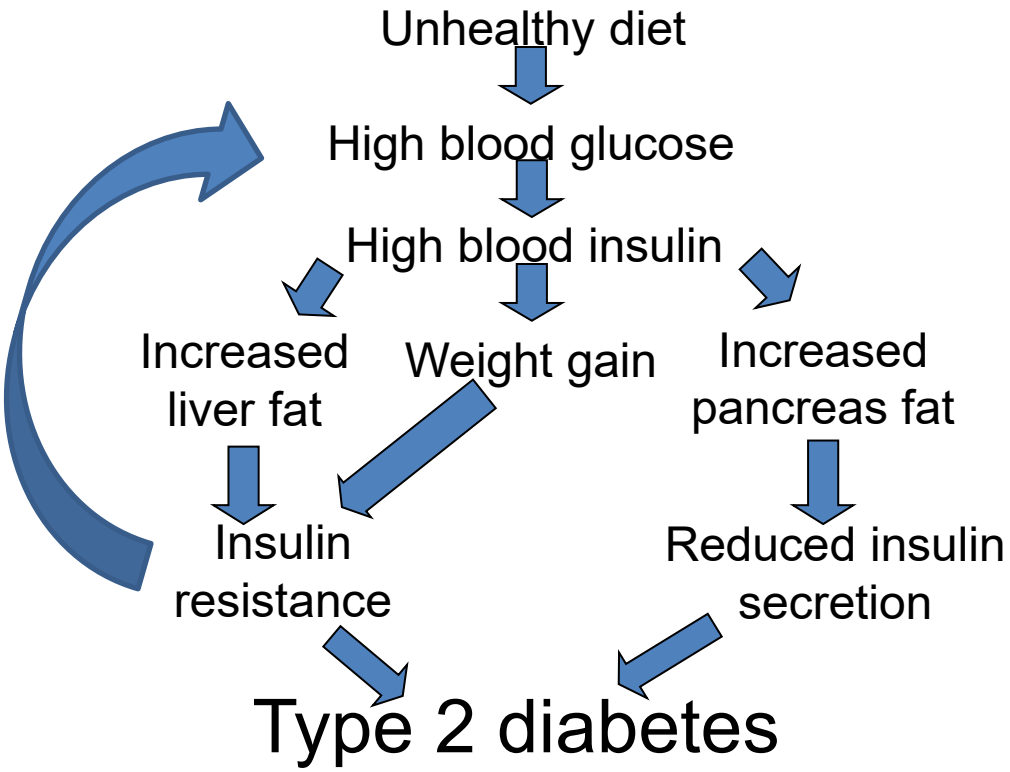
- Very low calorie diet (800 kcal/day) for 8 weeks
- MRI liver and pancreas to calculate fat content
- Studies to measure insulin resistance and insulin secretion

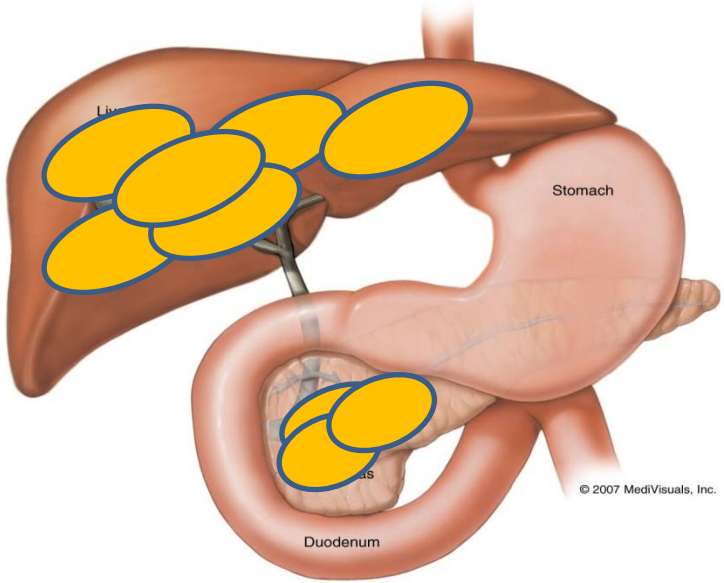
15kg weight loss

- Diabetes reversed → normal glucose tolerance
- Rapid loss of fat from liver → reduced insulin resistance
- Loss of fat from pancreas → improved insulin secretion

Lim EL, et al. Reversal of type 2 diabetes: normalisation of beta cell function in association with decreased pancreas and liver triacylglycerol. Diabetologia, 2011; 54: 2506-2514

Diet and development of type 2 diabetes





Development of diabetes

	Genetic predisposition	Environmental trigger

Development of diabetes

	Genetic predisposition	Environmental trigger
Type 1 diabetes		

Development of diabetes

	Genetic predisposition	Environmental trigger
Type 1 diabetes	HLA status	Virus?

Development of diabetes

	Genetic predisposition	Environmental trigger
Type 1 diabetes	HLA status	Virus?
Type 2 diabetes		

Development of diabetes

	Genetic predisposition	Environmental trigger
Type 1 diabetes	HLA status	Virus?
Type 2 diabetes	Ethnicity	
	Predisposing genes	

Development of diabetes

	Genetic predisposition	Environmental trigger
Type 1 diabetes	HLA status	Virus?
Type 2 diabetes	Ethnicity	Food environment
	Predisposing genes	

Effect of food environment

Type 2 diabetes prevalence in Pima Indians

Arizona – 38%



Mexico – 7%





Effect of food environment

Calories from ultra-processed foods:

UK – 50%

Italy – 14%



Remission of type 2 diabetes

Low calorie intake

↓

Lower blood glucose

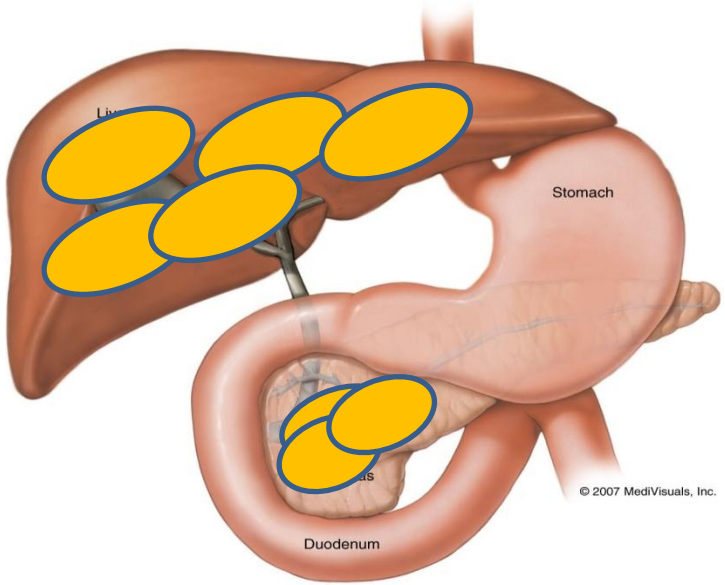
↓

Lower blood insulin

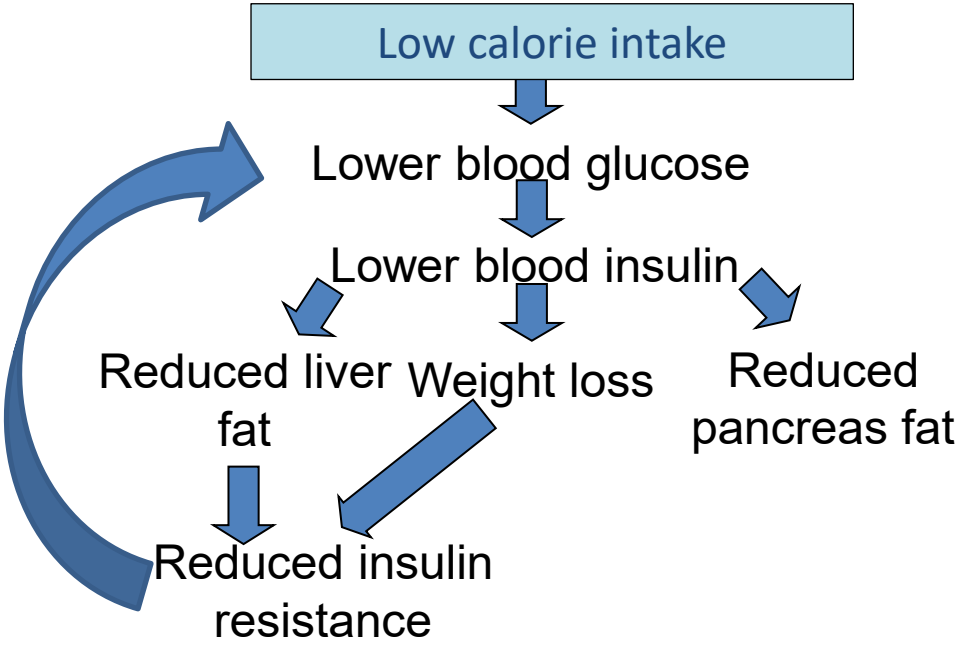
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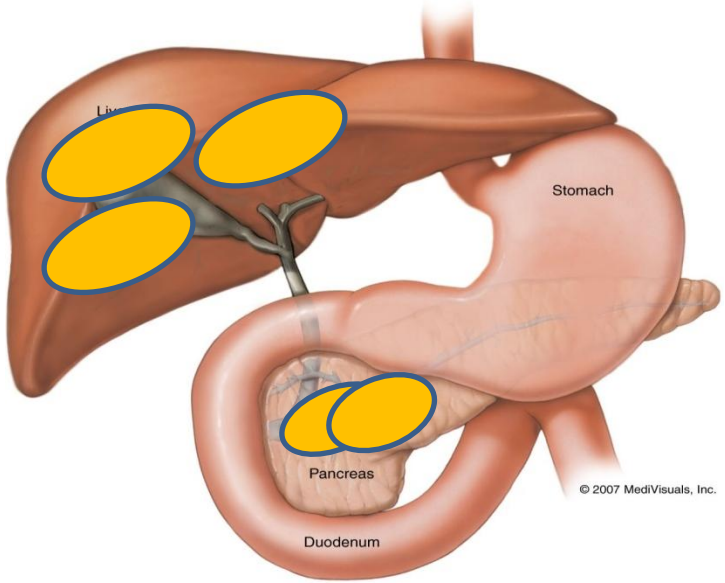
Reduced liver fat

Weight loss

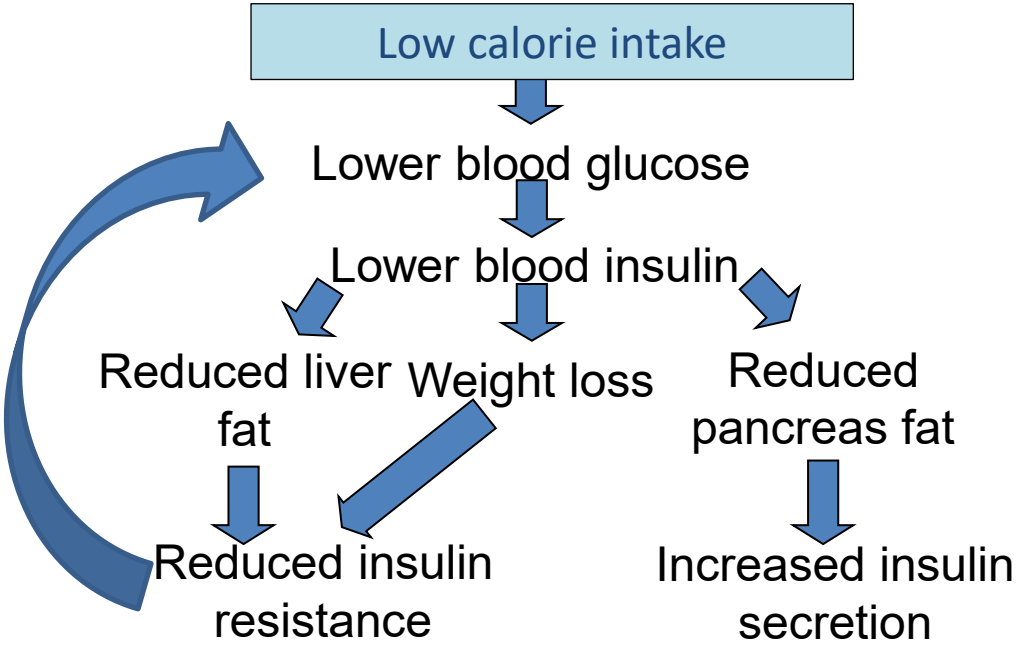


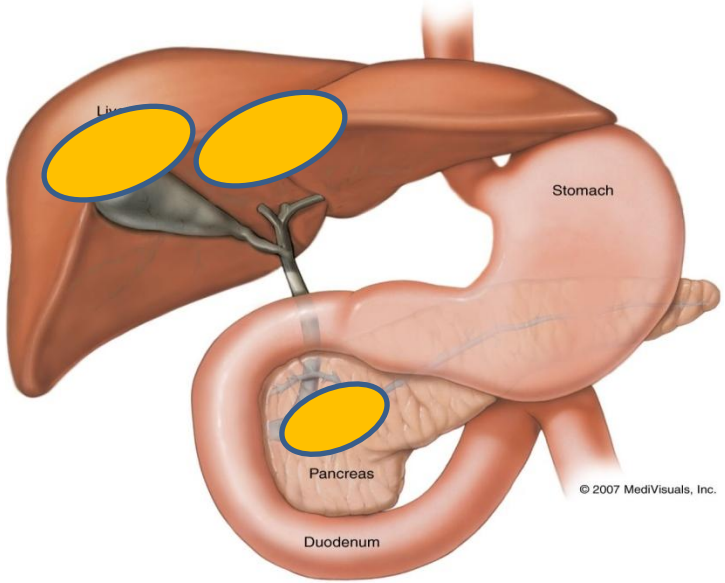
Remission of type 2 diabetes





Remission of type 2 diabetes





Remission of type 2 diabetes

Low calorie intake

Lower blood glucose

Lower blood insulin

Reduced liver fat

Weight loss

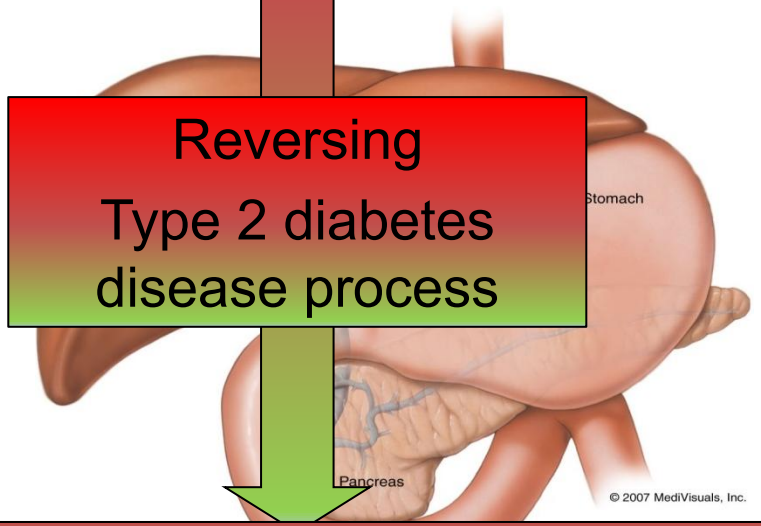
Reduced pancreas fat

Reduced insulin resistance

Increased insulin secretion

Type 2 diabetes in remission

Reversing Type 2 diabetes disease process



- HbA1c < 48mmol/mol (6.5%)
- No diabetes medication
- Maintained for at least three months

Very low calorie diet: The Diabetes Remission Clinical Trial (DIRECT)

- To determine if the results of the Counterpoint study can be replicated in a primary care setting

- Intervention:
  - All diabetes and BP medication stopped
  - 800 cal/day replacement diet for 12 weeks with stepped food reintroduction
  - Structured monthly support, with return to 800cal diet and/or diabetes meds as required

	Baseline	1 year	2 years	5 years*
Weight (kg)	100.4	90.4	92.8	93.9
HbA1c (mmol/mol) %	60 7.7	51 6.8	54 7.1	65 8.1
% in remission	0	46	36	13

Lean et al. Lancet Diabetes Endocrinology 2019; 7: 344–55
*Lean et al. Lancet Diabetes Endocrinol 2024; 12: 233–46

Evidence from DiRECT

- Rapid weight loss using a very low-calorie diet can be an effective short-term intervention
- Long term data suggest high relapse rate
- Those that didn’t gain weight stayed in remission
- Essential that subjects do not return to previous eating patterns – recommended to limit carbohydrates long term

Path to Remission programme

Am I eligible?

- Registered with a GP practice in Dorset
- Aged 18-65 inclusive
- Diagnosed with Type 2 diabetes within the last 6 years
- Have a Body Mass Index (BMI) of at least 27 (or 25 if you are of South Asian or Black African or Black Caribbean ethnicity)
  - Calculate your BMI here if unsure
- Attended your monitoring and diabetes review, including retinal screening, if you've been offered it
- Have an HbA1c (blood glucose) level of:
  - 43-87mmol/mol if on diabetes medications
  - 48-87mmol/mol if NOT on diabetes medications

If you're unsure about any of these please ask your GP practice.

These criteria have been set out by NHS England's Expert Advisory Group.

Unfortunately this is NOT the right service for you if you:

- Are prescribed insulin
- Are currently breastfeeding
- Are pregnant - or planning to be in the next 6 months
- Have had bariatric surgery
- Have one or more of: Active cancer; heart attack or stroke in last 6 months; severe heart failure; severe kidney disease; active liver disease (not including NAFLD); active substance use disorder; active eating disorder; porphyria; or known proliferative retinopathy that has not been treated (unless newly diagnosed and not yet offered)
- Have been assessed by a healthcare professional that you are not able to safely participate in the programme.

If you're unsure about any of these please ask your GP practice.

Path to Remission programme

- 14224 referred up to September 2024
- 72% signed up
- 63% started Total Diet Replacement (TDR), of whom
  - 53% completed 12 month follow up
  - 14% achieved remission

Valabhji, ABCD presentation 2025
Valabhji et al, Lancet Diab Endo 2024

Achieving remission of type 2 diabetes

- Very low-calorie diet (800cal / day)
- Therapeutic carbohydrate reduction
  - Ketogenic (very low carbohydrate) diet
    - <50g carbohydrate per day
  - Patient-led carbohydrate reduction
    - <100g carbohydrate per day

Remission of type 2 diabetes

Low **carbohydrate** intake

Lower blood glucose

Lower blood insulin

Reduced liver fat

Weight loss

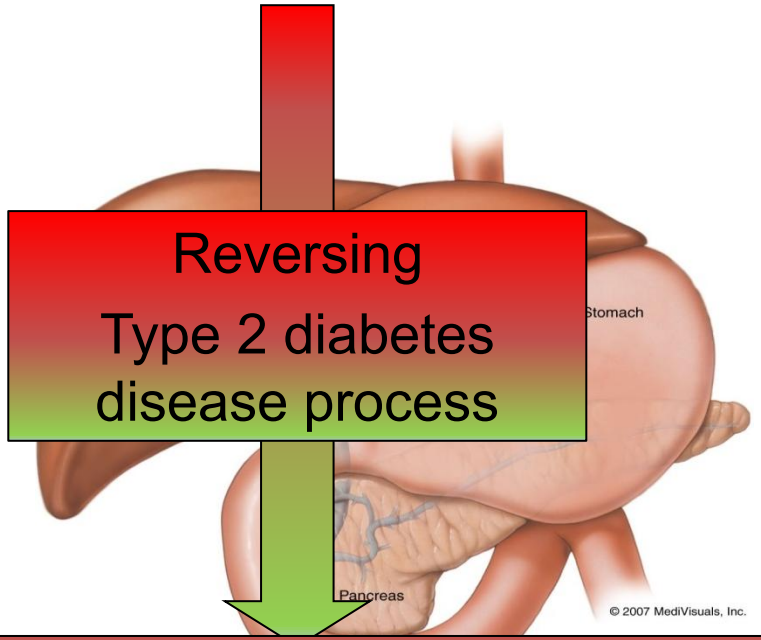
Reduced pancreas fat

Reduced insulin resistance

Increased insulin secretion

Type 2 diabetes in remission

Reversing Type 2 diabetes disease process



- HbA1c < 48mmol/mol (6.5%)
- No diabetes medication
- Maintained for at least three months

Ketogenic diet: Virta Health study

- Very low carb ketogenic diet
  - <30g carbohydrate per day – so body burns fat for energy (ketogenic)
  - Blood ketone monitoring (aim 0.5-3mmol/l)
  - Online professional and peer support

	Baseline	1 year	2 years	5 years*
Weight (kg)	115.3	100.3	102.6	107.6
HbA1c (mmol/mol) %	59 7.6	45 6.3	51 6.8	55 7.2
% in remission**	0	62	54	23

**60% stay on metformin

Hallberg et al, Diabetes Ther 2018; 9: 583-612
McKenzie et al, Diab Res Clin Prac. https://doi.org/10.1016/j.diabres.2024.111898*

Evidence from Virta Health study

- Nutritional ketosis is sustainable long term and can lead to significant weight loss and remission of diabetes
- The diet is restrictive (excludes all sugars and starches and most fruits) and is not suitable for everyone

- HOWEVER mean ketone levels were 0.3 mmol/l suggesting many were not in ketosis, yet still achieved good outcomes

Hallberg et al, Diabetes Ther 2018; 9: 583-612

Patient-led carbohydrate reduction



Avoid sugars
Reduce refined carbohydrates
Replace beige with green



Base meals on protein and veg

Dr David Unwin, Norwood Surgery, Southport

- Offered carb reduction as an option since 2013
- Follow up in routine consultations
- Open access group sessions attended by 50% of participants

- 51% remission after average 33 months

- Spend on diabetes medications 50% less than other local practices

N=128	Baseline	33 months
Weight (kg)	97	86
HbA1c (mmol/mol) HbA1c (%)	63 7.9	46 6.4
SBP (mmHg)	140	132
Total cholesterol	4.9	4.3
HDL-cholesterol (mmol/l)	1.1	1.2
TC:HDL ratio	4.0	3.9
% in remission	0	51

Unwin D, et al. What predicts drug-free type 2 diabetes remission? Insights from an 8-year general practice service evaluation of a lower carbohydrate diet with weight loss.

BMJ Nutrition, Prevention & Health 2023;e00544. doi:10.1136/bmjnph-2022-000544

Dr David Unwin, Norwood Surgery, Southport

Remission rate for:

Prediabetes 96%

Newly diagnosed Type 2 77%

Those who did not achieve remission had greater improvement in HbA1c!

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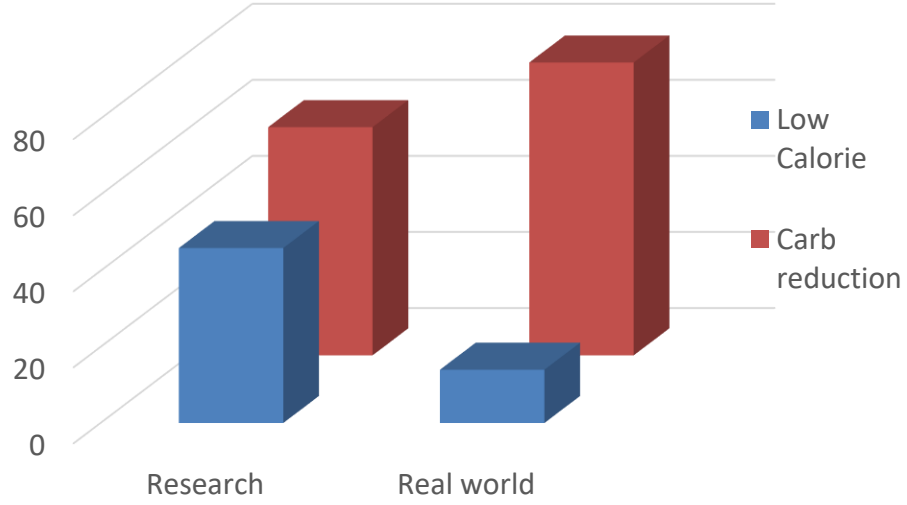
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Remission – does it work?

1 year remission rates:

- Very low calorie
  - Research (DIRECT) – 46%
  - Real world (Path to Remission) – 14%
- Carbohydrate reduction
  - Research (Virta) – 60%
  - Real world (Unwin) – 77%



Management of Hyperglycemia in Type 2 Diabetes, 2018. A Consensus Report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD)

Melanie J. Davies,[1,2] David A. D'Alessio,[3] Judith Fradkin,[4] Walter N. Kernan,[5] Chantal Mathieu,[6] Geltrude Mingrone,[7,8] Peter Rossing,[9,10] Apostolos Tsapas,[11] Deborah J. Wexler,[12,13] and John B. Buse[14]

https://doi.org/10.2337/dci18-0033

Medications/therapies in class	Primary physiological action(s)	Advantages	Disadvantages/adverse effects	Efficacy
• Mediterranean type • DASH • Low carbohydrate	• Depends on diet	• Inexpensive • No side effects	• Requires instruction • Requires motivation • Requires lifelong behavioral change	Intermediate

- Low-carbohydrate diets improve glycaemic control

5. Facilitating Positive Health Behaviors and Well-being to Improve Health Outcomes: *Standards of Care in Diabetes—2023*

Diabetes Care 2023;46(Suppl. 1):S68–S96 | https://doi.org/10.2337/dc23-S005

Nuha A. ElSayed, Grazia Aleppo, Vanita R. Aroda, Raveendhara R. Bannuru, Florence M. Brown, Dennis Bruemmer, Billy S. Collins, Marisa E. Hilliard, Diana Isaacs, Eric L. Johnson, Scott Kahan, Kamlesh Khunti, Jose Leon, Sarah K. Lyons, Mary Lou Perry, Priya Prahalad, Richard E. Pratley, Jane Jeffrie Seley, Robert C. Stanton, Deborah Young-Hyman, and Robert A. Gabbay, on behalf of the American Diabetes Association

- Reducing overall carbohydrate intake for individuals with diabetes has demonstrated the most evidence for improving glycaemia
- For select adults with type 2 diabetes, a low or very low carbohydrate eating plan is a viable approach

Recent guidelines summarised in:

Kelly et al (2020) Low-Carbohydrate Diets in the Management of Obesity and Type 2 Diabetes: A Review from Clinicians Using the Approach in Practice. Int. J. Environ. Res. Public Health 2020, 17(7), 2557; https://doi.org/10.3390/ijerph17072557

Diabetes around the world | 2021

Number of adults (20–79 years) with diabetes worldwide

World

2045	784 million
2030	643 million
2021	537 million

46% increase

North America & Caribbean (NAC)

2045	63 million
2030	57 million
2021	51 million

24% increase

Europe (EUR)

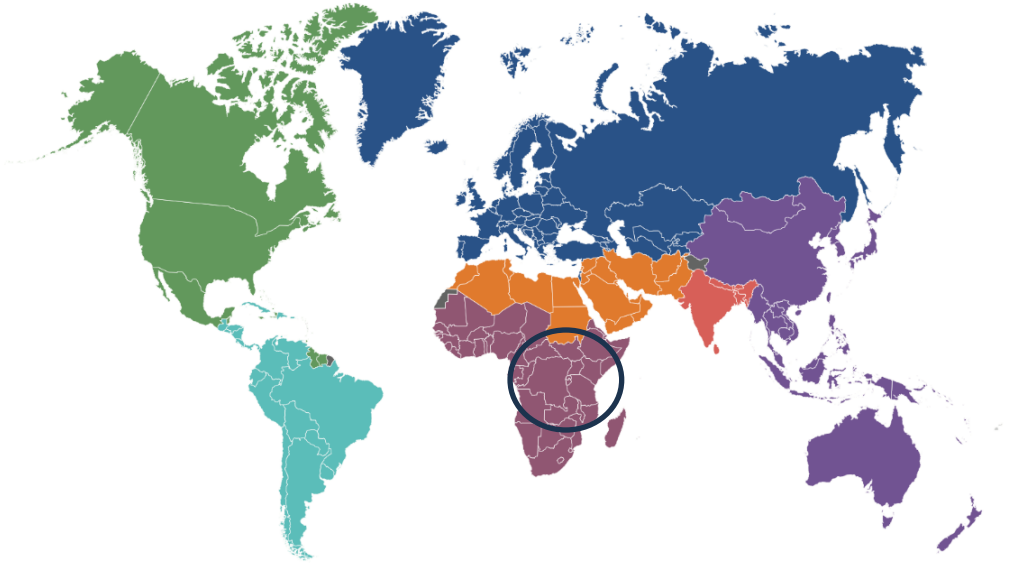
2045	69 million
2030	67 million
2021	61 million

13% increase

Western Pacific (WP)

2045	260 million
2030	238 million
2021	206 million

27% increase



South & Central America (SACA)

2045	49 million
2030	40 million
2021	32 million

50% increase

Africa (AFR)

2045	55 million
2030	33 million
2021	24 million

134% increase

Middle East & North Africa (MENA)

2045	136 million
2030	95 million
2021	73 million

87% increase

South-East Asia (SEA)

2045	152 million
2030	113 million
2021	90 million

68% increase

Kenya







Kenya

Remission achieved in the slums and the gated communities



DR Congo

Dr David Cavan
@DrDavidCavan

Boost

Freedom from type 2 diabetes in DR Congo 👍

Emmanuel K... @kan... · 31 May 2023

Je me suis remis de mon diabète 6 mois après grâce au régime alimentaire et un sport régulier sous l'accompagnement du Dr @CCikomola de @hpgrbukavu que je remercie sincèrement.



Medication cannot be the solution to type 2 diabetes

- In lower income countries, medications are often unavailable or unaffordable – lifestyle change is the only sustainable option

- Recent drug shortages in the UK demonstrate we cannot rely on medications to manage type 2 diabetes

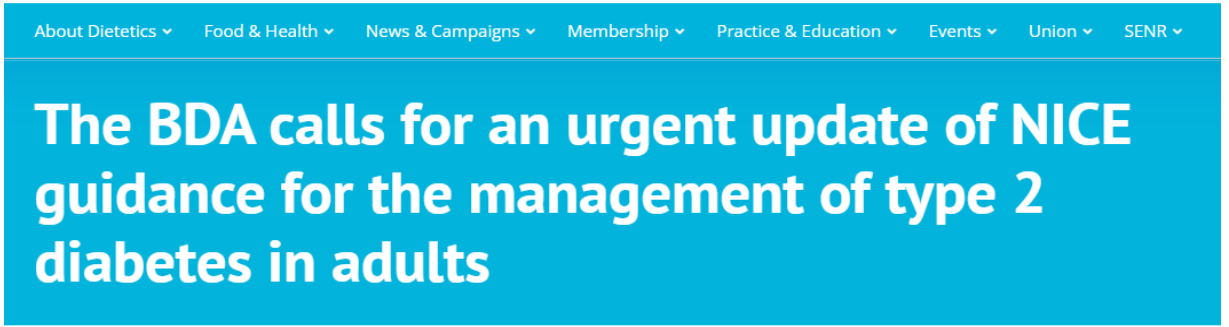
What does NICE say about remission?

- NOT A LOT!

2026 NICE guideline

- Same format since 2009
- Diet and lifestyle advice unchanged since 2009 (2 pages of 124)
- Focus on medications – amended 2015, 2022 and 2026
  - Metformin and SGLT2 for all

NICE guidelines



- No update to dietary section since 2009
- Public Health Collaboration, X-Pert Health and British Dietetic Association wrote to NICE requesting update in 2026

- They declined to do so

17 March 2025

The BDA has written to the National Institute for Health and Care Excellence (NICE), alongside representatives from X-PERT Health and the Public Health Collaboration to request an urgent update of the dietary advice section of guideline NG28, which relates to the management of type 2 diabetes in adults.

The guidance hasn't been updated since 2009, despite the significant advances in the understanding of this area, nor has it kept pace with other national and international guidelines that have been updated, causing confusion for healthcare professionals as to what they should be recommending.

Under the current guidance flexible approaches and the use of a range of different dietary options aren't supported. They also do not include remission of type 2 diabetes as a suitable treatment target. These areas do not support patient choice or increase patient hope.

Read the full letter here, outlining further concerns with the current guidance.

What does NICE say about remission?

- “Read this guideline alongside the NHS Type 2 diabetes Path to **Remission** Programme” – 11 times!

- But remember…

NICE was set up to assess medications and technologies for cost-effectiveness

Which is very different from an overall management guideline

Think beyond NICE

- NICE provides guidance on management of type 2 diabetes using medications

- It has nothing to say about achieving remission through lifestyle change

JOURNAL OF METABOLIC HEALTH, VOL 9, NO 1 (2026)

Guidelines

A Delphi consensus-based guideline for the implementation of therapeutic carbohydrate reduction in metabolic disorders

Sarah M. Rice, Laura A. Buchanan, Matthew W. Calkins, Mark T. Cucuzzella, Robert Cywes, Pamela L. Devine, Miriam Kalamian, Tro Kalayjian, Douglas B. Reynolds, Eric C. Westman

Received: 30 Apr. 2026; **Accepted:** 20 July 2026; **Published:** 02 Oct. 2026



Summary

- Type 2 diabetes is a condition of carbohydrate intolerance
- It is the result of modern lifestyle, including overconsumption of refined carbohydrates
- Without lifestyle change it becomes a progressive condition requiring increasing medication
- With carbohydrate reduction it can be managed with less medication and in many cases reversed.

- **Patient-led carbohydrate reduction should be the cornerstone of management of type 2 diabetes**

Thank you for your attention

Dr David Cavan, Consultant Endocrinologist
University Hospitals Dorset
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